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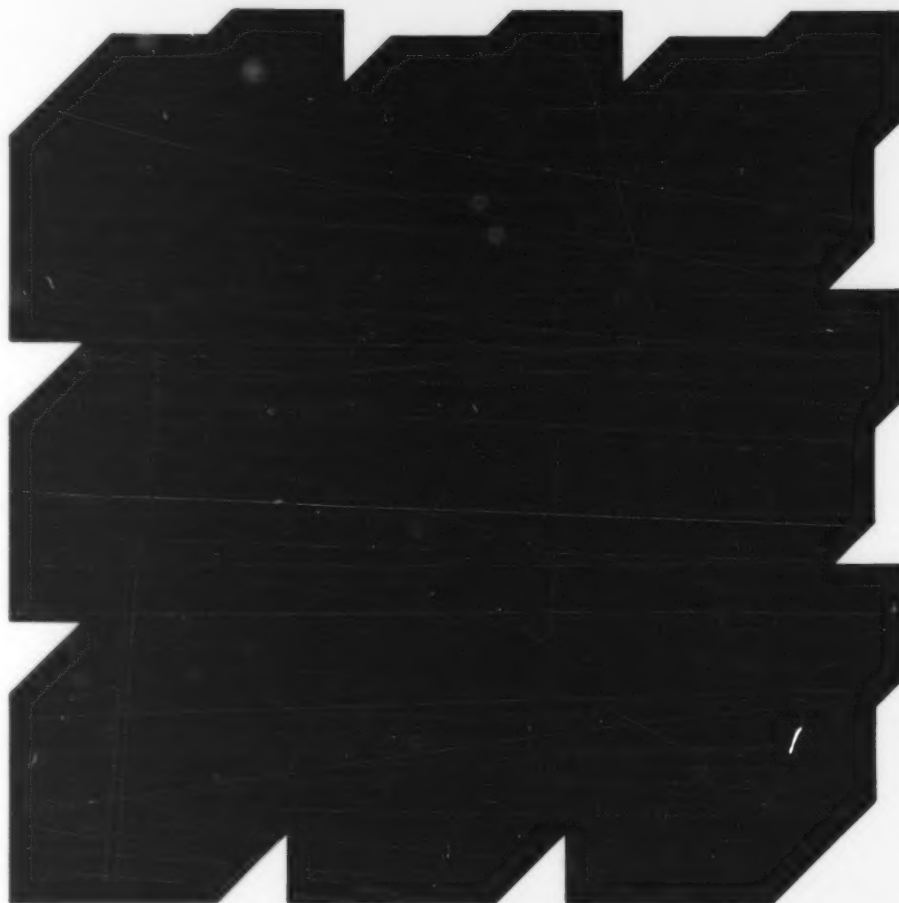
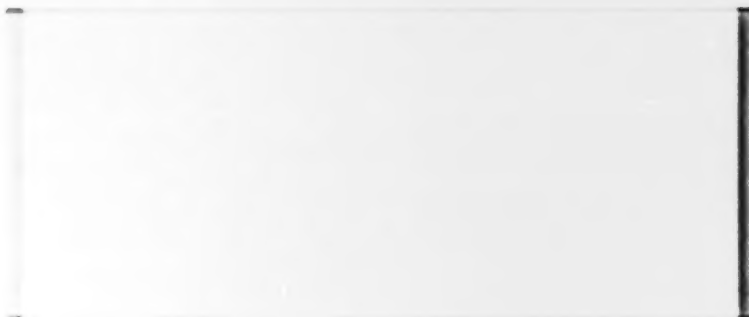


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DISCUSSION PAPER NO. 308

The Role of Tax-Deductible Saving in the
Transition from a Progressive Income Tax
to a Progressive Consumption Tax

by

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and Fadle Naqib

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RÉSUMÉ

Les auteurs du présent document examinent les effets (en situation d'équilibre et en période de transition) de la conversion d'un impôt progressif sur le revenu (y) en un impôt progressif de consommation (c). Ils ont procédé à des simulations dont les résultats démontrent que des gains d'efficacité dynamique considérables pourraient être réalisés en adoptant un impôt progressif de consommation, où toute épargne serait déductible aux fins d'impôt. Ils examinent également un autre régime fiscal (r) qui permettrait à la fois des épargnes déductibles et non déductibles de l'impôt. Ils démontrent que non seulement un tel régime fiscal serait une façon pratique d'instaurer un impôt progressif de consommation, mais également qu'un régime fiscal (r) n'imposant aucune limite à l'épargne déductible de l'impôt pourrait même se révéler plus efficace qu'un impôt progressif de consommation dans une situation d'équilibre.



ABSTRACT

This paper examines the steady state and transition effects of converting from a graduated income (y) tax to a graduated consumption (c) tax. Our simulation results suggest that considerable dynamic efficiency gains could be achieved by switching to a graduated c-tax, where all saving is tax-deductible. An alternative (r) tax system, permitting both tax-deductible and nontax-deductible saving, is also examined. It is shown that not only is such a tax system a feasible way of implementing a progressive c-tax, but also an r-tax without any limits on tax-deductible saving could be more efficient than even a progressive c-tax in a steady state.



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I. INTRODUCTION

Most recent studies concerning the merits of switching from a personal tax based on income to one based on consumption involve comparisons of proportional taxes.¹ Their general conclusion is that substantial steady state efficiency gains could be achieved by converting to a consumption tax because the latter, unlike an income tax, does not distort the choice between current consumption and saving for future consumption.²

The desirability of switching to a consumption tax can, nevertheless, be disputed on a number of grounds. First, while the presumption that a consumption tax does not affect the trade-off between an individual's consumption at different dates is true in the context of proportional taxes (and perfect capital markets), it is generally false in the case of a graduated consumption tax. Consequently, the foregoing efficiency argument for preferring a consumption tax to an income tax is no longer valid.³ Second, it ignores the fact that consumption as well as income taxes distort the choice between work and leisure.⁴ Third, conversion to a consumption tax that raises the same amount of revenue as an income tax would significantly increase the tax burden on older generations and could therefore be viewed as inequitable.⁵

Curiously enough, with the exception of Fullerton et al. (1983), research on the subject has stopped short of investigating the impact of switching from a graduated income tax to a graduated consumption tax⁶ even though anything other than a graduated personal tax appears to be politically unacceptable on vertical equity grounds. The theoretical literature's preoccupation with proportional taxes has perhaps reinforced the widely held impression that the efficiency gains attendant upon conversion to a consumption tax are largely at the expense of progressivity in the tax structure. As pointed out by the U.S. Treasury Blueprints for Basic Tax Reform and the Meade Committee Report, however, a consumption tax could be designed to be every bit as progressive as an income tax.

Implementation of a graduated consumption tax requires the estimation of taxpayers' consumption indirectly. This involves permitting the deduction of saving from income to give the tax base; that is, the tax-deductible or registered saving method.⁷ Conversion to a graduated consumption tax would result in all saving being registered and taxpayers who had saved for future consumption prior to the changeover would suffer the burden of being taxed not only on the income that had been saved under the previous income tax regime, but also the unexpected additional burden under the new regime when such savings were used for consumption purposes. Again a relatively large share of the burden would be borne by persons who had saved for their old age. There would be a strong incentive, therefore, to conceal wealth

held on the changeover date, which could seriously disrupt capital markets.

One way of mitigating these intergenerational transfers from the old to the young would be to leave taxpayers free to distribute their savings between registered and non-registered assets. That to some extent is what has been happening in Canada since the introduction of registered retirement savings plans (RRSPs) in 1957. The subsequent periodic relaxation of the limits on contributions to such schemes has resulted in a gradual shift from a progressive income tax to a progressive consumption tax, a process which seems certain to accelerate over the next few years.⁸

The purpose of this paper is to fill a gap in the theoretical literature by comparing steady states in a life-cycle growth model under both a progressive income tax and a progressive consumption tax, and investigating the transition from one steady state to the other. Judging from our simulation results, considerable dynamic efficiency gains could be achieved by switching to a progressive consumption tax where all saving must be registered. An alternative tax system where taxpayers are at liberty to choose the degree to which savings are registered or not is also examined. In addition, some distributional implications of the different tax systems are discussed.

The rest of the paper is organized as follows. Section II describes the theoretical model underlying our simulations. The results of these simulations are reported in Section III. Finally, the implications of our results for tax policy are discussed in Section IV.

II. SIMULATION MODEL

A. Theoretical Framework

As the behaviour of steady state economies has been analyzed in a previous study,⁹ here we confine our attention to the features of our model necessary to understand the analysis of the transition paths from one tax system to another.

Our model consists of a competitive economy with three sectors: (1) a household sector comprised of overlapping generations of identical individuals with a rate of population growth of n per cent, (2) a production sector employing capital and labour, and (3) a government sector which raises a fixed amount of revenue from personal taxes irrespective of the tax base. Government expenditure is assumed to consist only of government consumption so that the capital stock is due exclusively to household saving.

We assume a progressive personal tax schedule of the form

$$\tau = \phi z^{\phi}, \quad 0 < \tau' < 1, \quad \tau'' > 0, \quad (1)$$

where z is the tax base, τ denotes the taxes paid by the individual in each period, τ' is the marginal tax rate, and ϕ and ϕ are parameters of the tax schedule. Three tax bases are compared: income (y), consumption (c), and income minus tax-deductible or registered saving ($y-r$). Obviously, if different tax regimes are required to collect a fixed amount of revenue per capita, $\bar{T}$, then either ϕ or ϕ or both must change with the adoption of a new tax base. In the subsequent simulations of the effects of switching from an income tax to a consumption tax, we keep ϕ constant¹⁰ and allow ϕ to vary so that the total taxes raised are equivalent to an average overall tax rate of 24 per cent under an income tax.¹¹

The essential features of our general equilibrium model are captured by two equations:

$$k^d(i, \phi, x) = k^s(i), \quad (2)$$

$$\text{and } T(i, \phi, x) = \bar{T}. \quad (3)$$

Equation (2) involves the assumption of capital market equilibrium, that is, the demand for capital (assets) per unit of labour income, k^d , equals the supply, k^s . The market rate of

interest is denoted by i , and x is a vector of other known parameters of the model. Equation (3) ensures that each tax base yields the same amount of tax revenue. These two equations can be solved for the two unknowns i and ϕ , which in turn enable us to calculate wage rates along with the capital-labour ratios and saving propensities under each tax regime.¹²

Expressions for k^d and T are derived by aggregating the behaviour of every individual at each age, t , under alternative tax bases. The representative person is assumed to start work at economic age 0 with an initial endowment of assets $w(0) > 0$, retire at age R , and die at age D leaving bequests to his heirs $w(D) > 0$. He plans a stream of consumption, $c(t)$, and bequests in order to maximize his lifetime utility function, u , subject to an expected lifetime budget constraint.¹³ More specifically,

$$u = \int_0^D \frac{c(t)^{1-\delta}}{1-\delta} e^{-\rho t} dt + \frac{w(D)^{1-\delta}}{1-\delta} e^{-\rho D}. \quad (4)$$

The budget constraint under an income (y) tax is

$$\dot{w}(t) = i w(t) + \omega - \phi [i w(t) + \omega]^\phi - c(t), \quad (5)$$

where ω is the wage rate and a dot over a variable denotes the derivative of that variable with respect to age. With a consumption based (c) tax

$$\dot{w}(t) = i w(t) + \omega - \phi [c(t)]^\psi - c(t). \quad (6)$$

If taxpayers are permitted to deposit (or withdraw) any amount $r(t)$ to (or from) registered accounts, where contributions are tax-deductible (and withdrawals are taxable), and at the age of retirement, R , total registered assets $v(R)$ are used to purchase an annuity yielding an annual income of b until death,¹⁴ the individuals budget constraint is

$$\dot{w}(t) = \begin{cases} i w(t) + \omega - r(t) - \phi [i w(t) + \omega - r(t)]^\psi - c(t), & 0 \leq t \leq R \\ i w(t) + b - \phi [i w(t) + b]^\psi - c(t), & R \leq t \leq D \end{cases}$$

and (7)

$$v(t) = \begin{cases} i v(t) + r(t), & 0 \leq t \leq R \\ i v(t) - b, & R \leq t \leq D \end{cases}$$

The foregoing will be referred to as an r -tax.

Maximization of (4) subject to the budget constraints corresponding to different tax bases yields the demand for assets by a representative person at each age, and by aggregating over all individuals we arrive at the aggregate demand for assets.

The aggregate supply of assets is derived from an aggregate production function which is assumed to be of Cobb-Douglas type:

$$Q = A K^{\alpha} L^{1-\alpha}, \quad (8)$$

where Q is the total output, A denotes a scaling factor, L is the amount of labour used, and α is capital's share of output. Each factor is assumed to be paid its marginal product so that

$$i = \alpha A k^{\alpha-1}, \quad (9)$$

$$\text{and } \omega = (1-\alpha) A k^{\alpha}, \quad (10)$$

where $k = K/L$.

B. The Transition Path from an Income Tax to a Consumption Tax

We define p as the number of periods elapsing after conversion to a consumption tax, where 0 is the period in which the conversion is made, and $p = (1, 2, \dots)$. A representative individual's age is denoted by $a = (0, 1, \dots, R, \dots, D)$, where $R = 45$ and $D = 55$. Future time is denoted by t , $a < t < D$. Accordingly, the variables for each individual at age a are indexed as $c_{p,a}(t)$, $w_{p,a}(t)$, $\tau_{p,a}(t)$, etc. Hence, $c_{4,2}(2)$, for example, denotes the consumption of a person of economic age 2 in the fourth period after conversion to a consumption tax, and $c_{4,2}(3)$ is the planned consumption in the next year of the same person. Parameters are indexed with the subscript p alone so that i_p , ω_p and ϕ_p are the interest, wage, and tax parameters p years after conversion.

We start with an economy at its steady state under a y -tax. The population consists of 56 cohorts and grows at the constant rate $n = 1.5$ per cent. The income, consumption, and saving profiles of each cohort is known, having been derived by each individual's maximization of (4) subject to (5).

Upon conversion to a c -tax, individuals in each cohort replan their consumption and saving for the remainder of their lives by maximizing (4) subject to (6) rather than (5). In doing so, they have to form expectations concerning the interest rate, wages, and the personal tax schedule. Following Summers (1979) and Seidman (1984), "steady state expectations" are assumed implying that each person behaves as if he expects the interest and wage rates as well as the parameters of the tax schedule to remain at their current values throughout the rest of his life.

However, only the values of consumption and saving planned for the first year after conversion are relevant as the individual will replan everything once again next year as the interest rate, wages, and the tax schedule adjust to the current changes in individuals' consumption and saving behaviour. For instance, in the p th year after conversion, the lifetime profile of asset accumulation of a person aged a is $w_{p,a}(a), w_{p,a}(a+1), \dots, w_{p,a}(D)$. Hence, for each cohort we obtain a value for $w_{p,a}(a)$ where $a = 0, 1, \dots, D$. It follows that w_p , the aggregate stock of assets held p years after conversion to a c -tax is

$$w_p = \lambda^p \left[\sum_{a=0}^D w_{p,a}(a) \lambda^{-a} \right] = k_p, \quad (11)$$

where $\lambda = 1+n$. Substitution of the resulting capital stock, k_p , and labour for period p into the production function, and applying the marginal conditions (9) and (10), we obtain the interest and wage rates to be used in period $p+1$. The tax parameter ϕ for that period is derived by ensuring that the tax per unit of labour is equal to that which would have been raised in the steady state under the y -tax. The foregoing process is repeated in each period until the capital-labour ratio converges to its new steady state under the c -tax. The following summarizes the procedure for one period, p .

From the previous period, we have i_{p-1} , w_{p-1} and ϕ_{p-1} together with

$$w_{p,a}(a) = w_{p-1,a-1}(a) \quad (1 \leq a \leq D), \quad (12)$$

$$\text{and } w_{p,0}(0) = \frac{w_{p-1,D}^{(D)}}{(1+n)^D}. \quad (13)$$

The latter ensures that the inheritances of the cohort starting its working life are equal to the bequests of the deceased cohort.

Our optimization problem is to maximize:

$$u_a = \int_a^D \frac{c_{p,a}(t)^{1-\delta}}{1-\delta} e^{-\rho t} dt + \frac{w_{p,a}(D)^{1-\delta}}{1-\delta} e^{-\rho D}, \quad (14)$$

subject to

$$\dot{w}_{p,a}(t) = \begin{cases} i_{p-1} w_{p,a}(t) + \omega_{p-1} - \phi_{p-1} [c_{p,a}(t)]^{\phi} - c_{p,a}(t), & t < R, \\ i_{p-1} w_{p,a}(t) - \phi_{p-1} [c_{p,a}(t)]^{\phi} - c_{p,a}(t), & R < t < D \end{cases} \quad (15)$$

for all $a = 0, \dots, D-1$. This is a standard optimal control problem.

By applying Pontryagin's Maximum Principle and eliminating the costate variable, we find that $c_{p,a}(t)$ is optimal if it satisfies the differential equation

$$\dot{c}_{p,a}(t) = \frac{\mu_{p-1} c_{p,a}(t) \{1 + \phi \phi_{p-1} [c_{p,a}(t)]^{\phi-1}\}}{1 + \phi \phi_{p-1} (1 + \frac{\phi-1}{\delta}) [c_{p,a}(t)]^{\phi-1}}, \quad (16)$$

where $\mu_{p-1} = \frac{i_{p-1} - \rho}{\delta},$

and the boundary condition

$$[w_{p,a}(D)]^{\delta} = [c_{p,a}(D)]^{\delta} \{1 + \phi \phi_{p-1} [c_{p,a}(D)]^{\phi-1}\}, \quad 0 \leq a \leq D-1. \quad (17)$$

Equation (17) can be used to select $c_{p,a}(D)$ where $a = D$.

The optimal state variable $w_{p,a}(t)$ is

(i) $a < R$

$$w_{p,a}(t) = \begin{cases} e^{i_{p-1}(t-a)} w_{p,a}(a) + (e^{i_{p-1}(t-a)} - 1) \omega_{p-1} / i_{p-1} - h(t,a) e^{i_{p-1}t} & a < t < R \\ e^{i_{p-1}(t-a)} w_{p,a}(R) - e^{i_{p-1}t} h(t,R), & R < t < D \end{cases} \quad (18)$$

(ii) $a > R$

$$w_{p,a}(t) = e^{i_{p-1}(t-a)} w_{p,a}(a) - h(t,a) e^{i_{p-1}t}, \quad a < t < R,$$

$$\text{where } h(t_2, t_1) = \int_{t_1}^{t_2} e^{-i_{p-1}s} \{c_{p,a}(s) + \phi_{p-1} [c_{p,a}(s)]^\psi\} ds.$$

From the foregoing optimization problem we get K_p as expressed in equation (11) and since labour grows exogenously at the rate n ,

$$L_p = L_{-1} \lambda^P, \quad (19)$$

where L_{-1} is labour in the steady state. Substituting K_p and L_p into the production function and using conditions (9) and (10), we obtain

$$i_p = \alpha A k_p^{\alpha-1} \quad (20)$$

$$\text{and } \omega_p = (1-\alpha) A k_p^\alpha. \quad (21)$$

The tax parameter ϕ_p is obtained by solving the equation

$$\lambda^p \phi_p \sum_{a=0}^D [c_{p,a}(a)]^\psi \lambda^{-a} = \lambda^p \bar{T}, \quad (22)$$

which ensures that the tax per unit of labour is equal to what it would have been under a y-tax.

Aggregate consumption C_p is

$$C_p = \lambda^p \sum_{a=0}^D [c_{p,a}(a)] \lambda^{-a}. \quad (23)$$

C. The Transition Path to an Income Tax with Unlimited RRSPs

The transition to a progressive income tax with no limits on RRSP contributions is rather more complicated than the transition from a progressive income tax to a progressive consumption tax. Hence, the procedure is discussed here in more detail.

For a representative individual from each cohort $a = 0, \dots, D-1$, the optimization problem involves maximizing

$$u_a = \int_a^D \frac{c_{p,a}(t)^{1-\delta}}{1-\delta} e^{-\rho t} dt + \frac{w_{p,a}(D)^{1-\delta}}{1-\delta} e^{-\rho D}, \quad (24)$$

subject to

$$\dot{w}_{p,a}(t) = \begin{cases} i_{p-1} w_{p,a}(t) + \omega_{p-1} - r_{p,a}(t) - c_{p,a}(t), & t < R, \\ i_{p-1} w_{p,a}(t) + b_a - r_{p,a}(t) - c_{p,a}(t), & R \leq t < D, \end{cases} \quad (25)$$

$$\text{and } \tau_{p,a}(t) = \begin{cases} \phi_{p-1} [i_{p-1} w_{p,a}(t) + \omega_{p-1} - r_{p,a}(t)]^\psi, & t < R, \\ \phi_{p-1} [i_{p-1} w_{p,a}(t) + b_a], & R \leq t < D, \end{cases} \quad (26)$$

$$w_{p,a}(a) = w_{p-1, a-1}(a) \quad 1 \leq a \leq D \quad (27)$$

$$w_{p,0}(0) = \frac{w_{p-1, D}(D)}{(1+n)^D}; \quad (28)$$

$$\text{and } \dot{v}_{p,a}(t) = \begin{cases} i_{p-1} v_{p,a}(t) + r_{p,a}(t), & t < R, \\ i_{p-1} v_{p,a}(t) - b_a, & R \leq t < D \end{cases} \quad (29)$$

$$\text{where } v_{p,a}(a) = v_{p-1, a-1}(a), \quad 1 \leq a \leq D \quad (30)$$

$$v_{p,0}(0) = 0, \quad v_{p,D}(D) = 0. \quad (31)$$

The control variables are $c_{p,a}(t)$ and $r_{p,a}(t)$, the state variables are $w_{p,a}(t)$ and $v_{p,a}(t)$, while b_a is a control parameter.

The Hamiltonian function is:

(i) $t < R$

$$\begin{aligned} H = & \frac{e^{-\rho t} [c_{p,a}(t)]^{1-\delta}}{1-\delta} + \sigma_2 \{i_{p-1} v_{p,a}(t) + r_{p,a}(t)\} \\ & + \sigma_1 \{i_{p-1} w_{p,a}(t) + \omega_{p-1} - r_{p,a}(t) - c_{p,a}(t)\} \end{aligned} \quad (32)$$

(ii) $R \leq t \leq D$

$$H = \frac{e^{-\rho t} [c_{p,a}(t)]^{1-\delta}}{1-\delta} + \sigma_2 \{i_{p-1} v_{p,a}(t) - b_a\} \\ + \sigma_1 \{i_{p-1} w_{p,a}(t) + b_a - \tau_{p,a}(t) - c_{p,a}(t)\},$$

where σ_1 and σ_2 are the two costate variables corresponding to $w_{p,a}$ and $v_{p,a}$ respectively,

The optimal values of $c_{p,a}(t)$, $r_{p,a}(t)$ and b_a are those which maximize H . The first-order conditions for an interior maximum are:

$$\frac{\partial H}{\partial c_{p,a}} = 0 \text{ or } [c_{p,a}(t)]^{-\delta} e^{-\rho t} = \sigma_1, \quad (33)$$

$$\frac{\partial H}{\partial r_{p,a}} = 0 \text{ or } \sigma_1 (1 - \tau'_{p,a}(t)) = \sigma_2, \quad a \leq t \leq R, \quad (34)$$

$$-\frac{\partial H}{\partial w_{p,a}} = \dot{\sigma}_1 \text{ or } -\sigma_1 i_{p-1} (1 - \tau'_{p,a}(t)) = \dot{\sigma}_1, \quad (35)$$

$$-\frac{\partial H}{\partial v_{p,a}} = \dot{\sigma}_2 \text{ or } -i_{p-1} \sigma_2 = \dot{\sigma}_2. \quad (36)$$

(1) The optimal $c_{p,a}(t)$

Differentiating (33) with respect to t and using (35) yields

$$\dot{c}_{p,a}(t) = c_{p,a}(t) (i_{p-1} (1-\tau'_{p,a}(t)) - \rho)/\delta. \quad (37)$$

The transversality condition is:

$$c_{p,a}(D) = w_{p,a}(D). \quad (38)$$

(2) The optimal $r_{p,a}(t)$

Differentiating (34) with respect to t and using (35) and (36) yields

$$\dot{i}'_{p,a}(t) = i_{p-1} (1-\tau'_{p,a}(t)) \tau'_{p,a}(t), \quad a \leq t \leq R, \quad (39)$$

which implicitly describes the optimal path of $r_{p,a}(t)$.

With b_a a control parameter, it follows that

$$\int_R^D \frac{\partial H}{\partial b_a} dt = 0, \quad (40)$$

which implies that

$$\int_R^D [\sigma_1 (1-\tau'_{p,a}(t)) - \sigma_2] dt = 0. \quad (41)$$

Substituting for σ_1 from (34) and noting that (34) and (36) imply that

$$\sigma_2(t) = \sigma_2(R) e^{-i_{p-1}(t-R)} \quad (42)$$

$$\text{and } \sigma_2(R) = \sigma_1(R) (1-\tau'_{p,a}(R)), \quad (43)$$

(40) can thus be rewritten as:

$$\tau'_{p,a}(R) = 1 - \frac{i_{p-1}[c_{p,a}(R)]^\delta e^{(p-i_{p-1})R}}{e^{-i_{p-1}R} - e^{-i_{p-1}D}} \int_R^D (1-\tau'_{p,a}(t)) [c_{p,a}(t)]^{-\delta} dt. \quad (44)$$

(3) The optimal b_a

From equations (29) and (31) we have

$$\dot{v}_{p,a}(t) = i_{p-1} v_{p,a}(t) - b_a, \quad R \leq t \leq D \quad (45)$$

$$\text{and } v_{p,a}(D) = 0. \quad (46)$$

Integrating from D to t we get

$$e^{-i_{p-1}t} v_{p,a}(t) = e^{-i_{p-1}D} v_{p,a}(D) - \int_D^t e^{-i_{p-1}\eta} b_a d\eta, \quad (47)$$

which can be rewritten as

$$v_{p,a}(t) = \left[\frac{1 - e^{-i_{p-1}(t-D)}}{i_{p-1}} \right] b_a. \quad (48)$$

Since b_a is constant for all $R \leq t \leq D$,

$$b_a = \frac{i_{p-1} v_{p,a}(R) e^{-i_{p-1}R}}{e^{-i_{p-1}R} - e^{-i_{p-1}D}}. \quad (49)$$

Note that although b_a is constant for each individual from R to D, it varies by cohort a. In the steady state, however, b_a is the same for all cohorts.

Substituting the optimal values of the control variables, $c_{p,a}(t)$ and $r_{p,a}(t)$ and the control parameter b_a into equations (25) and (29), we can then solve for the optimal $w_{p,a}(t)$ and $v_{p,a}(t)$. The aggregate stock of capital at period p is therefore

$$K_p = \lambda^p \left[\sum_{a=0}^D w_{p,a}(a) \lambda^{-a} + \sum_{a=0}^D v_{p,a}(a) \lambda^{-a} \right], \quad (50)$$

which along with L_p can be substituted into equations (19) and (20) to yield i_p and ω_p .

The tax parameter ϕ_p , is derived from the government's budget constraint. Whereas with a switch to a c-tax, ϕ_p was adjusted in order to ensure that taxes per unit of labour were the same as that under a y-tax, if it were still operating, maintaining such a constraint upon conversion to an r-tax would require tax rates exceeding 100 per cent on taxable income. This is because the tax base shrinks drastically as individuals reduce their tax payments by converting their non-registered assets into the registered type, while no taxes are yet raised from the annuity income derived from registered assets. A disproportionate burden of the resulting high tax rates would fall on retired persons.

Such intergenerational transfers of tax burdens could be attenuated in a number of ways. First, instead of allowing unrestricted use of registered saving immediately, the r-tax could be phased-in by gradually relaxing limits on contributions to registered saving plans, a procedure which is in fact being followed in Canada. Second, the shortfall in tax revenues could be made up by increasing other taxes, such as those levied on wages. Third, the government could run a temporary budget deficit.

Unfortunately, combining simulations of the phasing-in of the r-tax and the transition from a y-tax to an r-tax would be extremely expensive to simulate as the steady state under an r-tax would only be reached after a very long period of time. And although the drop in personal tax revenues could be offset by raising other taxes, we prefer to exclude other taxes from our model in order to keep it as simple as possible. Hence, we adopt the temporary deficit route.

More specifically, we place an upper limit of 0.4 on the value of ϕ_p , and let the government run a deficit immediately after the switch to an r-tax (that is, collecting less taxes than would have been raised under a y-tax) and then a surplus (that is, more taxes than under a y-tax) until the time p^* is reached, where the present value of taxes actually collected is equal to the present value of taxes that would have been collected over the same period of time under a y-tax. After p^* the tax parameter ϕ_p is adjusted to ensure that taxes per unit of labour is the same as that under a y-tax. The appropriate value of p^* is calculated as the least value of q for which the following equation is satisfied:

$$\sum_{p=0}^q (\hat{T}_p - T_p) > 0, \quad (51)$$

where $\hat{T}_p$ is the present value of taxes collected,

$$\begin{aligned} \hat{T}_p = 0.4 \lambda^p \left\{ \sum_{a=0}^R [i_{p-1} w_{p,a}(a) + \omega_{p-1} - r_{p,a}(a)]^\phi \lambda^{-a} \right. \\ \left. + \sum_{a=R+1}^D [i_{p-1} w_{p,a}(a) + b_a]^\phi \lambda^{-a} \right\} / (1+i_{p-1})^p, \end{aligned} \quad (52)$$

$$\text{and } T_p = \lambda^p \bar{T} / (1 + i_{p-1})^p, \quad (53)$$

where $\bar{T}$ denotes the taxes collected in a steady state under a y-tax. T_p is thus the present value of desired taxes.

III. SIMULATION RESULTS

A. Conversion to a Progressive Consumption Tax

Simulations of the transition from a progressive y-tax to a progressive c-tax are reported in Table 1. Each simulation begins at an initial steady state under a y-tax. The c-tax is then introduced and the tax parameter ϕ is adjusted in every period p in order to keep tax revenue per unit of labour, T/L , equal to what it would have been under the y-tax. The economy gradually converges to the higher values of ω , K/L , Y/L , C/L , and S/L shown in the penultimate column of each table. The robustness of the results is examined by running simulations for three values of δ ; 0.75, 1.0, and 1.5.

Table 1

Conversion from a Progressive Income Tax to a Progressive Consumption Tax

	Y-Tax Steady State	First Year of Conversion	% Change Upon Conversion	Nth Year After Conversion*	C-Tax Steady State	% Change Between Steady States
$\delta = 0.75$						
i	0.080	0.080	0	0.060	0.057	-29
ω	0.982	0.982	0	1.082	1.100	+12
K/L	4.095	4.095	0	5.986	6.406	+56
Y/L	1.310	1.310	0	1.442	1.466	+12
T/L	0.304	0.304	0	0.304	0.304	0
C/L	0.942	0.684	-27	0.941	1.070	+14
S/L	0.061	0.321	+426	0.197	0.092	+51
$\delta = 1.0$						
i	0.082	0.082	0	0.063	0.059	-28
ω	0.982	0.982	0	1.077	1.098	+12
K/L	3.976	3.976	0	5.719	6.160	+55
Y/L	1.310	1.310	0	1.436	1.463	+12
T/L	0.304	0.304	0	0.304	0.304	0
C/L	0.946	0.738	-22	0.952	1.070	+13
S/L	0.060	0.268	+347	0.180	0.089	+48
$\delta = 1.5$						
i	0.087	0.087	0	0.068	0.063	-28
ω	0.982	0.982	0	1.065	1.093	+11
K/L	3.761	3.761	0	5.189	5.769	+53
Y/L	1.309	1.308	0	1.419	1.475	+13
T/L	0.304	0.304	0	0.304	0.304	0
C/L	0.949	0.798	-16	0.947	1.071	+13
S/L	0.056	0.207	+270	0.168	0.082	+46

Notes: * Consumption per unit labour reached the same level as that obtaining in a steady state under a Y-tax during the Nth year after conversion; N = 9 where $\delta = 0.75$, and N = 10 where $\delta = 1.0$ or 1.5.

$\rho = 0.05$, $n = 0.015$, $\alpha = 0.25$, $R = 45$, $D = 55$, and $\phi = 1.311$.

According to these simulations a c-tax steady state would be achieved only after about 118 years. The variables would, however, reach 90 per cent of their c-tax steady state values within 10 years of the conversion. After that they would move very slowly towards their steady state levels.

As expected, conversion to a c-tax leads to a reduction in the level of consumption during the first few years following the changeover. Consumption per unit of labour, C/L , does not regain its level under the y-tax until after 9 or 10 years. The reduction in C/L during the first year of conversion varies between 16 and 27 per cent, depending on the value of δ . Moreover, as shown in Table 2, the foregoing loss of consumption is not shared equally among generations. Rather it is biased against the young and the old, the two groups whose consumption exceeds income.

Conversion to a c-tax also imposes a disproportionately heavy tax burden on the older generation. Whereas taxes paid per unit of income by the working population (that is, those persons aged between 0 and 45) drops considerably in the first year of conversion, the average tax rate on income borne by retirees (that is, persons aged 45 and over) increases dramatically (see Table 3). A typical simulation shows that the young (aged 0 to 20) pay 22 per cent of their income in taxes under a y-tax, while the middle aged (20 to 45) pay 23 per cent, and the old, 13 per cent. By contrast, in the first year of conversion to a c-tax,

Table 2

Loss in Consumption per Unit of Labour by Cohort in the First Year
After Conversion to a C-Tax

Age	Percentage Loss in Consumption per Unit of Labour (C/L)		
	$\delta = 0.75$	$\delta = 1.0$	$\delta = 1.5$
0	34	26	18
5	33	26	18
10	32	25	17
15	31	24	17
20	29	23	16
25	28	22	15
30	26	21	15
35	24	20	15
40	24	20	16
45	27	25	22
50	28	25	23
53	29	26	23
55	36	29	23

Table 3

Distribution of Tax Burden Among Age Cohorts in the First Year
After Conversion to a C-Tax

	Taxes/Income					
	$\delta = 0.75$		$\delta = 1.0$		$\delta = 1.5$	
	Y-Tax	C-Tax	Y-Tax	C-Tax	Y-Tax	C-Tax
0	0.217	0.116	0.217	0.135	0.217	0.157
5	0.220	0.116	0.220	0.135	0.220	0.157
10	0.224	0.120	0.224	0.138	0.223	0.160
15	0.227	0.124	0.226	0.141	0.227	0.162
20	0.230	0.128	0.230	0.144	0.230	0.163
25	0.234	0.132	0.234	0.147	0.234	0.165
30	0.238	0.136	0.238	0.149	0.242	0.162
35	0.241	0.138	0.241	0.149	0.242	0.162
40	0.246	0.136	0.246	0.145	0.246	0.154
45	0.251	0.124	0.251	0.130	0.254	0.134
50	0.165	0.520	0.166	0.532	0.167	0.534
53	0.138	0.942	0.139	0.980	0.140	0.994
55	0.120	2.192	0.102	2.553	0.103	2.930

the average tax rates on income become 13, 15, and 104 per cent for these three generations, respectively. Furthermore, this situation does not change as the economy moves towards a new steady state. In the c-tax steady state, the three generations face average tax rates on income of 17, 18 and 126 per cent, respectively. Consequently, switching from a progressive y-tax to a progressive c-tax is regressive as far as income is concerned in any single period after the changeover.

B. Conversion to a Progressive Income Tax with Unlimited RRSPs (r-tax)

The adverse distributional effect on older generations of switching from a progressive y-tax to a progressive c-tax strongly suggests that some instrument, such as RRSPs, may be useful in facilitating the transition to a c-tax. Judging from our simulations reported in Table 4, allowing taxpayers complete freedom in their use of registered and non-registered saving vehicles would not result in any reduction in consumption. Indeed, C/L rises slightly upon conversion to an r-tax. The main initial impact of switching to an r-tax, however, is to dramatically increase total saving per unit of labour, S/L, which is achieved through a huge loss in personal tax revenues and thus a government budget deficit. Long-run budget balance would only be reached after between 52 and 94 years, depending on the value of δ used.

Table 4

Conversion from a Progressive Income Tax without RRSPs
to One with Unlimited RRSPs

	Y-Tax Steady State	First Year of Conversion	% Change Upon Conversion	R-Tax Steady State	% Change Between Steady States
$\delta = 0.75$					
i	0.080	0.080	0	0.054	-33
ω	0.983	0.983	0	1.122	+14
K/L	4.094	4.094	0	6.924	+69
Y/L	1.310	1.310	0	1.496	+14
T/L	0.304	0.025	-92	0.304	0
C/L	0.942	0.968	+3	1.088	+15
S/L	0.061	0.317	+420	0.104	+70
$\delta = 1.0$					
i	0.082	0.082	0	0.053	-35
ω	0.982	0.982	0	1.140	+16
K/L	3.976	3.976	0	7.171	+80
Y/L	1.310	1.310	0	1.520	+16
T/L	0.304	0.013	-96	0.304	0
C/L	0.946	0.961	+2	1.108	+17
S/L	0.060	0.336	+460	0.108	+80
$\delta = 1.5$					
i	0.087	0.087	0	0.051	-41
ω	0.982	0.982	0	1.178	+20
K/L	3.761	3.761	0	7.700	+105
Y/L	1.309	1.309	0	1.571	+20
T/L	0.304	0.024	-92	0.304	0
C/L	0.949	0.986	+4	1.152	+21
S/L	0.056	0.300	+426	0.116	+107

Note $\rho = 0.05$, $n = 0.015$, $\alpha = 0.25$, $R = 45$, $D = 55$, and
 $\psi = 1.311$.

Interestingly enough, although the unlimited use of RRSPs is widely viewed as an important step in the direction of a progressive c-tax, our simulations summarized in Table 5 suggest that a steady state r-tax may in fact be superior to a c-tax from a dynamic efficiency standpoint. As discussed in Androkovich, Daly, and Naqib (forthcoming), this result is due to the "postponement effect" associated with the deferral of taxes through the use of an RRSP. The latter is a convenient do-it-yourself income 'averaging' device enabling taxpayers to rearrange taxable income over their lifetimes so that they are taxed at more uniform rates. Under a progressive income tax with unlimited use of RRSPs, larger contributions would be made to registered saving schemes than under a progressive consumption tax so that more of the tax burden would be shifted into the future. The postponement of tax burden reduces the present value of lifetime taxes for the representative individual in the steady state and the attendant wealth effect increases present as well as future desired consumption. The increase in desired future consumption leads to a rise in total saving.

IV. CONCLUSIONS

The foregoing simulations suggest that even with a graduated personal tax structure, substantial efficiency gains could be obtained by switching from an income-based to a consumption-based

Table 5

Ranking of Steady States Under Alternative Progressive Tax Systems

Tax System	i	ϕ	ω	K/L	Y/L	C/L	S/L	T/L
<u>$\delta = 0.75$</u>								
Progressive Income Tax with RRSPs	0.054	0.208	1.122	6.924	1.496	1.088	0.109	0.304
Progressive Consumption Tax	0.057	0.289	1.100	6.406	1.466	1.070	0.092	0.304
Progressive Income Tax	0.080	0.215	0.982	4.095	1.310	0.942	0.061	0.304
<u>$\delta = 1.0$</u>								
Progressive Income Tax with RRSPs	0.053	0.203	1.140	7.171	1.520	1.108	0.108	0.304
Progressive Consumption Tax	0.059	0.289	1.098	6.160	1.463	1.070	0.089	0.304
Progressive Income Tax	0.082	0.215	0.982	3.976	1.310	0.946	0.060	0.304
<u>$\delta = 1.5$</u>								
Progressive Income Tax with RRSPs	0.051	0.196	1.178	7.700	1.571	1.152	0.116	0.304
Progressive Consumption Tax	0.063	0.289	1.093	5.769	1.475	1.071	0.082	0.304
Progressive Income Tax	0.087	0.214	0.982	3.761	1.309	0.949	0.056	0.304

Note: These calculations assume $\rho=0.05$, $n=0.015$, $\alpha=0.75$, $R=45$, $D=55$ and $\psi=1.311$.

tax system. Unfortunately, these efficiency gains would be achieved partly at the expense of the older generation, who, at the time of the changeover, would experience large increases in tax burdens and accompanying losses in consumption. As a result, conversion to a consumption tax could be considered unfair and therefore perhaps politically unacceptable.

Such intergenerational transfers of tax burdens from the old to the young during the transition to a consumption-based personal tax system could be mitigated to a great extent by permitting taxpayers to freely distribute their savings between registered and non-registered assets, as implied by an r-tax, rather than requiring the registration of all assets as would be the case under a progressive c-tax.¹⁵ An r-tax would be fairer than a c-tax because taxpayers who had saved for their old age would not suffer the additional burden of being taxed again on such savings as they are used for consumption purposes. In addition, an r-tax could be more efficient than a c-tax in a steady state.

Immediate conversion to an r-tax would, however, lead to a flood of funds moving from unregistered to registered assets with serious short-run consequences for personal tax revenues after the changeover date. It would therefore be desirable to phase in the r-tax through a gradual relaxation of limits on registered saving as proposed in the 1984 and 1985 Federal Budgets under the guise of pension reform.

At this juncture, one should note that the r-tax simulated in our model differs considerably from the existing Canadian tax system. Strict limits are currently imposed on the annual amounts that can be contributed to RRSPs, and balances held in such accounts are constrained to be non-negative. Combining the phasing-in of an r-tax (by relaxing the limits on registered saving) with an examination of transition paths was not attempted, for reasons explained previously, while the non-negativity constraint on registered assets turns out to be non-binding in our simulations.

A more important discrepancy between the present Canadian tax system and the r-tax simulated in this paper involves the fact the tax-deductibility of interest payments on loans associated with RRSP contributions was eliminated in 1981. (This situation contrasts with that in the U.S. where interest on money borrowed to finance contributions to tax-deductible retirement savings schemes remains tax-deductible on the grounds that interest earned on this form of savings is tax-deferred rather than tax-exempt.) Needless to say, the elimination of the tax deduction for such interest payments would effectively eliminate the subsidy to saving provided under an r-tax system. Consequently, the reduction in personal tax revenues resulting from a switch to an r-tax would be attenuated. Removal of the subsidy to saving through the disallowance of interest deductions for loans used to

finance RRSP contributions would at the same time reduce the steady state efficiency gains associated with conversion to an r-tax.

Finally, as regards possible future research along similar lines, we shall attempt to simulate an r-tax system that does not permit the tax-deductibility of interest payments on loans used to finance registered saving. We shall also examine an alternative tax system, as described in Daly and Naqib (1985), where interest on both registered and non-registered savings are non-taxable, and interest payable on registered and non-registered loans are not tax-deductible.

NOTES

- 1 See, for example, Summers (1981), Auerbach and Kotlikoff (1983), Auerbach, Kotlikoff, and Skinner (1983), and Seidman (1984).
- 2 See, for example, Feldstein (1976).
- 3 See Daly and Naqib, (1985).
- 4 As far as Canada is concerned, however, empirical estimates of labour supply elasticities for prime age males and married women suggest that taxes have little influence on individual labour supply decisions. See, for example, Ham and Hsiao (1984) and Nakamura and Nakamura (1983).
- 5 See Meade (1978).
- 6 Auerbach, Kotlikoff, and Skinner (1983) compare a progressive income tax with a proportional consumption tax.
- 7 "Tax-deductible" and "registered" are used interchangeably.
- 8 The 1985 Federal Budget contained two important provisions which, if implemented, would constitute another major step in the direction of such an expenditure tax. First, the annual limit on RRSP contributions by individuals belonging to money purchase plans is to be raised in stages from its current level of \$5,500 to \$15,500 in 1990. Then, starting in 1991 contribution limits are to be indexed to the average industrial wage. Second, RRSP contributors will be allowed to carry forward any unused contributions for a period of seven years. As usual, this shift towards an expenditure-based personal tax system has been proposed under the guise of pension reform.
- 9 See Daly, Naqib, and Androkovich (forthcoming).
- 10 The value $\psi = 1.311$ used in our simulations was estimated from the 1984 Canadian income tax schedule so that the tax function (1) using in our simulations to some extent reflects the degree of progressivity embodied in Canada's current tax structure.
- 11 In 1982, total federal and provincial income taxes payable were approximately 24 per cent of taxable income assessed.
- 12 Our model involves a closed economy in which higher saving leads to lower interest rates and thus greater investment. Canada's ability to maintain an interest rate different to that prevailing in the rest of the world is, of course, limited

insofar as it is a small open economy and capital is mobile internationally. In such a situation, there would be little, if any, connection between domestic saving and domestic investment. Judging from the empirical evidence reported by Feldstein and Horioka (1980), Feldstein (1983) and Summers (1985), however, there appears to be a strong positive correlation between domestic savings and investment rates among O.E.C.D. countries, a phenomenon which indicates that capital may not be perfectly mobile internationally. Hence, our closed economy assumption is not inappropriate.

- 13 We ignore any labour supply response to changes in the tax system for the reason mentioned in footnote 4 above.
- 14 The current tax regulations require that before the end of the year in which the planholder turns seventy-one, the proceeds of an RRSP must be converted into an annuity or transferred to a registered retirement income fund (RRIF); otherwise the plan is deregistered and the entire balance subject to income tax in the same year. With regard to the annuity option, the individual has the choice between a life annuity and a fixed-term annuity which provides benefits until age ninety. If the planholder prefers to establish an RRIF, an increasing fraction of the fund must be withdrawn in each year so that it is depleted by the time the person reaches age ninety.
- 15 Even under a consumption tax, it is generally conceded that certain assets, such as, owner-occupied housing and consumer durables, would have to be designated as non-registered, and therefore subject to tax prepayment on administrative grounds. See, for example, the Meade Report and Bradford (1980).

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